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(54) **LAUNDRY TREATING APPLIANCE  
SUSPENSION SYSTEM**

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13, 2010.

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**37/268** (2013.01)

(58) **Field of Classification Search**

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See application file for complete search history.

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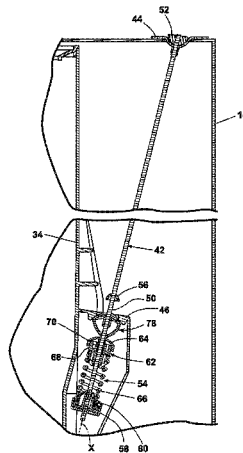
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(57) **ABSTRACT**

A suspension system for a laundry treating appliance having a cabinet and a tub comprises a rod coupled to the cabinet and a shock absorber coupled between the rod and the tub. A socket interface on the rod reduces side loading forces on the shock absorber. The socket interface may be separate from the shock absorber.

**14 Claims, 4 Drawing Sheets**



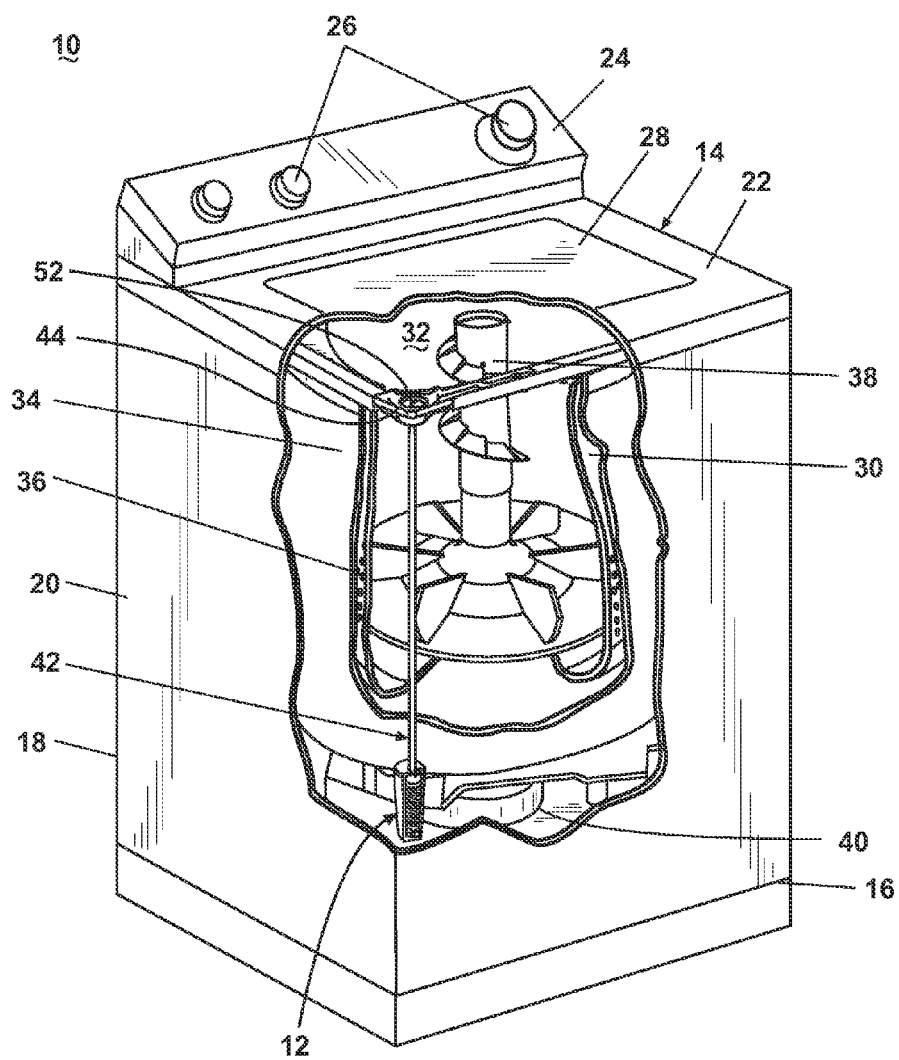


Fig. 1

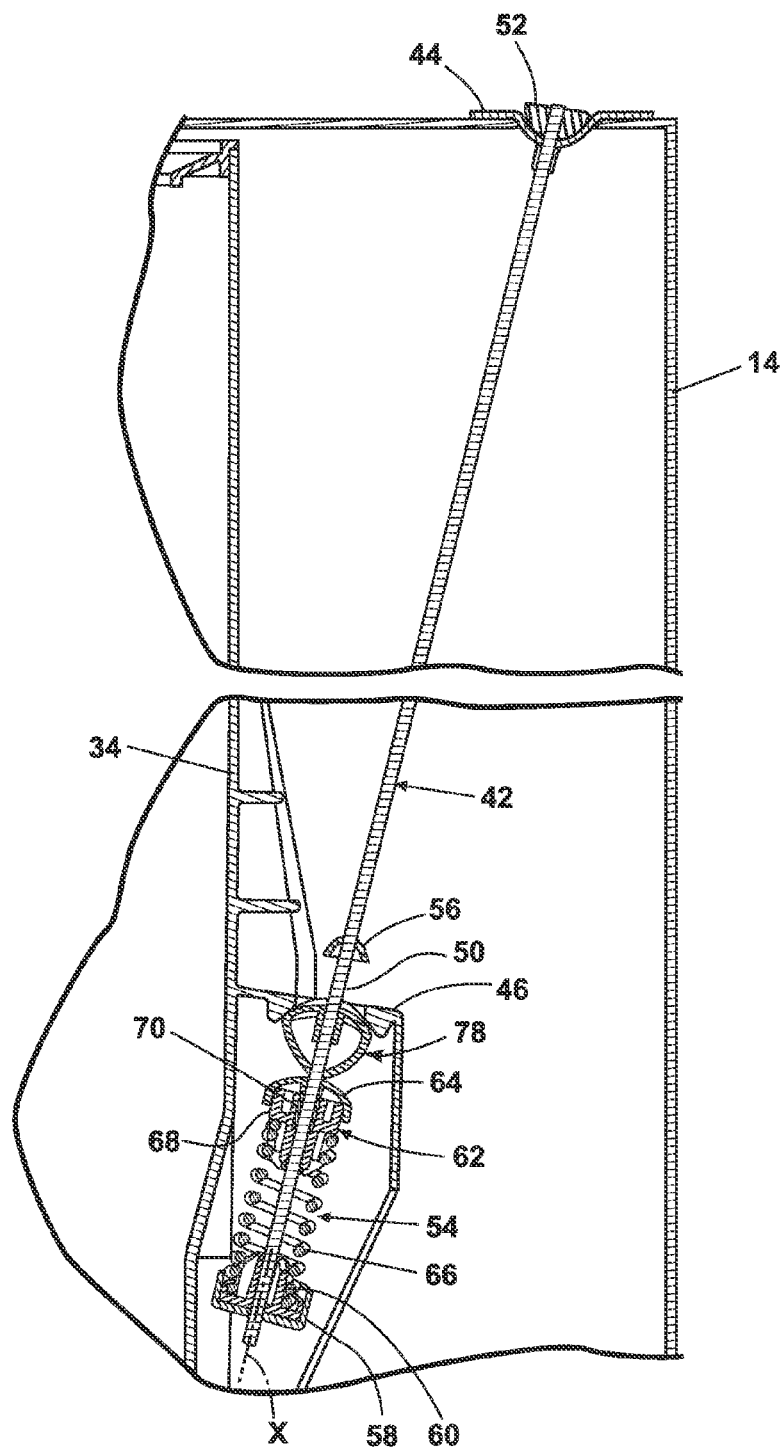


Fig. 2

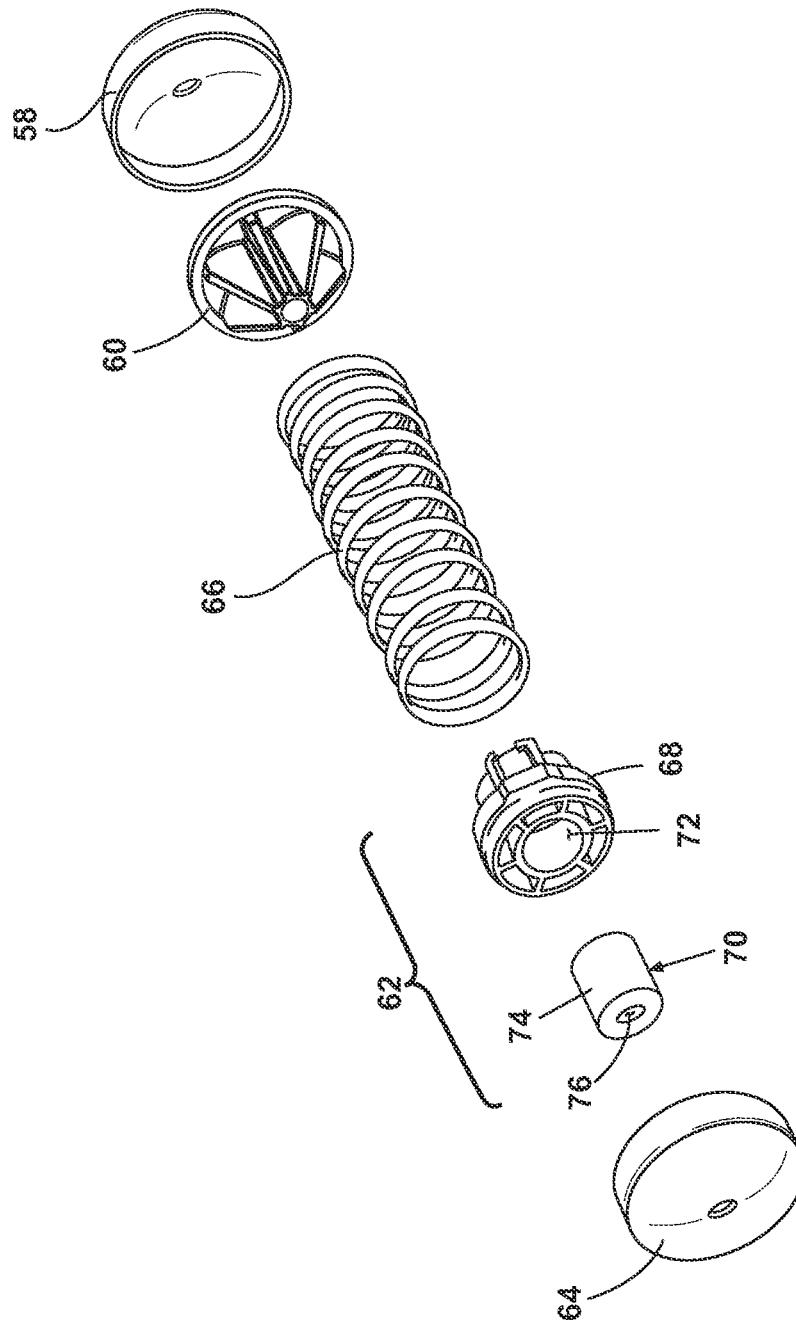


Fig. 3

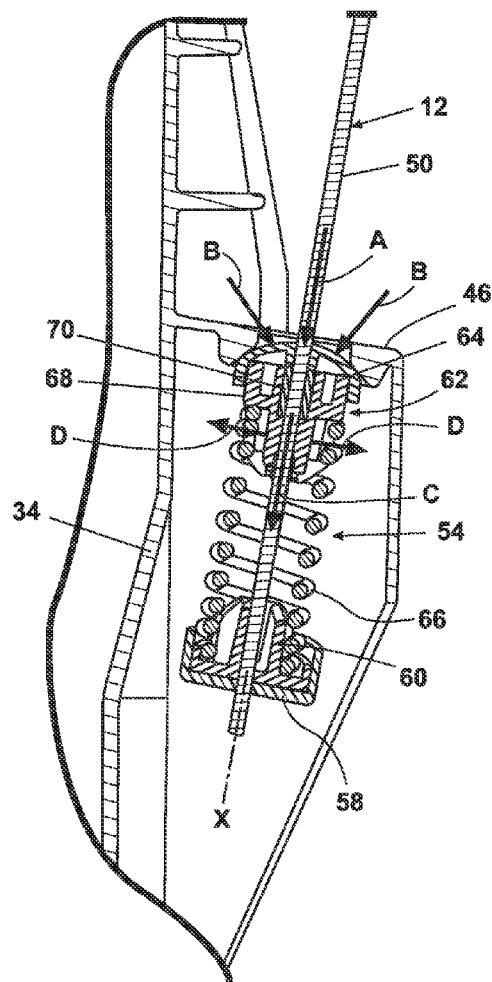


Fig. 4

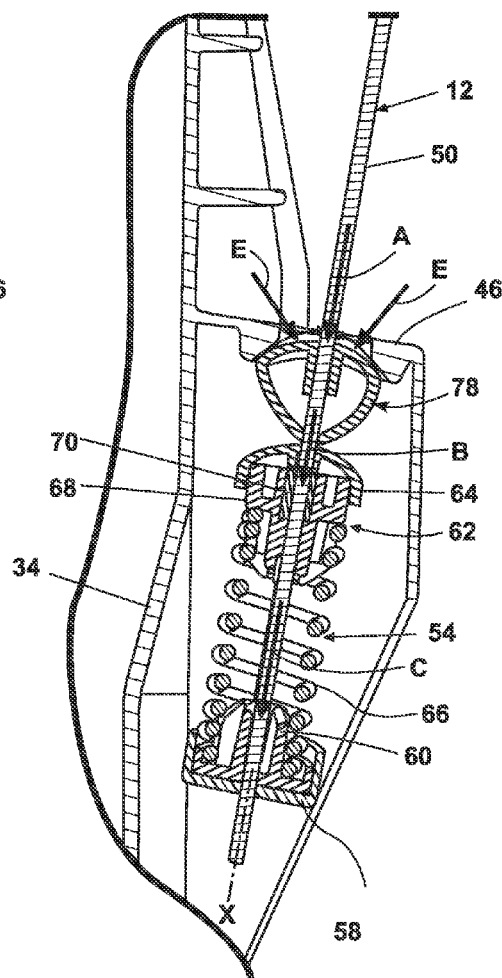


Fig. 5

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## LAUNDRY TREATING APPLIANCE SUSPENSION SYSTEM

### CROSS REFERENCE TO RELATED APPLICATIONS

The present application claims the benefit of U.S. Provisional Patent Application No. 61/323,451, filed Apr. 13, 2010, which is incorporated herein by reference in its entirety.

### BACKGROUND OF THE INVENTION

Laundry treating appliances, such as a washing machine or a clothes dryer, may include an outer cabinet and a tub housed within the cabinet and coupled to the cabinet by a suspension system. Such suspension systems may include a plurality of suspension strut assemblies which hang the tub from the cabinet. Each suspension strut assembly may have dampening means for reducing the movement and vibration of the tub.

### SUMMARY OF THE INVENTION

The invention relates to a suspension system for a laundry treating appliance having a cabinet and a tub. The suspension system includes a rod coupled to the cabinet, a shock absorber coupled between the rod and the tub, and a socket interface coupled to the rod which reduces side loading forces on the shock absorber.

### BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a perspective view of a laundry treating appliance, with a portion of the laundry treating appliance partially cut away to show interior components, including a suspension system according to one embodiment of the invention.

FIG. 2 is a partial sectional view of the laundry treating appliance from FIG. 1 and illustrating one suspension strut assembly of the suspension system.

FIG. 3 is an exploded view of a portion of the suspension system of FIG. 1, including a spring and damper of the suspension strut assembly.

FIG. 4 is a partial sectional view of the laundry treating appliance from FIG. 1, illustrating forces acting on the suspension system without the socket interface.

FIG. 5 is a partial sectional view of the laundry treating appliance from FIG. 1, illustrating forces acting on the suspension system with the socket interface.

### DESCRIPTION OF EMBODIMENTS OF THE INVENTION

The present invention relates to a suspension system for an appliance, such as a laundry treating appliance. In particular, one embodiment of the invention relates to a laundry treating appliance suspension system having an improved force management. FIG. 1 illustrates one embodiment of a laundry treating appliance 10 having a suspension system 12 according to one embodiment of the invention. As illustrated, the laundry treating appliance 10 is a vertical-axis washing machine; however, the laundry treating appliance 10 may be any appliance which performs a cycle of operation on laundry, non-limiting examples of which include a horizontal-axis washing machine; a horizontal or vertical axis clothes dryer; a combination washing machine and clothes dryer; a tumbling or stationary refreshing/revitalizing machine; an extrac-

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tor; a non-aqueous washing apparatus; and a revitalizing machine. As used herein, the term “vertical-axis” washing machine refers to a washing machine having a rotatable drum that rotates about a generally vertical axis relative to a surface that supports the washing machine. However, the rotational axis need not be perfectly vertical to the surface. The drum may rotate about an axis inclined relative to the vertical axis, with fifteen degrees of inclination being one example of the inclination. Similar to the vertical axis washing machine, the term “horizontal-axis” washing machine refers to a washing machine having a rotatable drum that rotates about a generally horizontal axis relative to a surface that supports the washing machine. The drum may rotate about the axis inclined relative to the horizontal axis, with fifteen degrees of inclination being one example of the inclination. The laundry treating appliance 10 described herein shares many features of a traditional automatic washing machine, which will not be described in detail except as necessary for a complete understanding of the invention. It is also understood that the suspension system 12 is applicable to appliances other than laundry treating appliances.

As illustrated in FIG. 1, the laundry treating appliance 10 may have a cabinet 14 defined by a front wall 16, a rear wall 18, and a pair of side walls 20 supporting a top wall 22. A user interface 24 on the cabinet 14 has multiple controls 26, which a user can select to operate the laundry treating appliance 10 through the steps of a wash cycle. A chassis or frame may be provided on which the various walls may be mounted.

The top wall 22 may have an openable door or lid 28 and may be selectively moveable between opened and closed positions to close an opening in the top wall 22, which provides access to the interior of the cabinet 14. A rotatable drum 30 may be disposed within the interior of the cabinet 14 and defines a treating chamber 32 for treating laundry. The drum 30 may be positioned within an imperforate tub 34. The drum 30 may include a plurality of perforations 36, such that liquid may flow between the tub 34 and the drum 30 through the perforations 36. A clothes mover 38 may be located in the drum 30 to impart mechanical agitation to a load of clothing articles placed in the drum 30. An electric motor 40 may be coupled to the clothes mover 38 and may be located beneath the tub 34.

At least the tub 34 is supported within the cabinet 14 by the suspension system 12. The suspension system 12 can comprise a plurality of suspension strut assemblies 42, only one of which is visible in FIG. 1, which hang the tub 34 from the cabinet 14. While the illustrated laundry treating appliance 10 includes both the tub 34 and the drum 30, with the drum 30 defining the laundry treating chamber 32, it is within the scope of the invention for the laundry treating appliance 10 to include only one receptacle, with the receptacle defining the laundry treating chamber for receiving the laundry load to be treated and supported by the suspension system 12.

FIG. 2 is a partial sectional view of the laundry treating appliance 10 from FIG. 1. Each suspension strut assembly 42 may be coupled to the cabinet 14 by one or more brackets 44, which can be positioned near the top corners of the cabinet 14, and to the tub 34 by one or more sockets 46, which can be integrally formed with or attached to a lower portion of the tub 34. Each suspension strut assembly 42 comprises a rod 50 having an upper support 52 at a first end of the rod 50 which is coupled to the bracket 44 and a shock absorber 54 at a second end of the rod 50, opposite the upper support 52, which is coupled to the socket 46. A stop 56 is also coupled to the rod 50 and functions to limit the upward movement of the tub 34 within the cabinet 14.

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The shock absorber 54 may comprise a first end cap 58, a piston 60, a damper 62, a second end cap 64, and a spring 66. The end caps 58, 64, piston 60, and damper 62 may be mounted on the rod 50, with the first end cap 58 nearest the terminal end of the rod 50, the piston 60 adjacent the first end cap 58, the damper 62 spaced from both the first end cap 58 and the piston 60, and the second end cap 64 adjacent the damper 62. The spring 66 may be mounted around the piston 60 and is positioned between the first end cap 58 and the damper 62. The spring 66 allows compliance in the connection of the tub 34 to the cabinet 14, aiding to reduce vibration and allow the tub 34 to move freely within the cabinet 14. The damper 62 may provide friction force that is used to reduce the movement and vibration of the tub.

FIG. 3 is an exploded view of a portion of the suspension system 12 of FIG. 1. The damper 62 may include an outer housing 68 a dampening insert 70 received by a chamber 72 in the outer housing 68. The dampening insert 70, which is illustrated as a compressible friction member, may be a tube 74 of foam material having a passage 76 for receiving the rod 50. The inner diameter of the tube 74, i.e. the diameter of the passage 76, may be smaller than the outer diameter of the rod 50, causing the inner surface of the tube 74 to compress outwardly in order for the tube 74 to stretch over the rod 50. The outer diameter of the tube 74 may be greater than the diameter of the chamber 72, thereby compressing at least the outer surface of the tube 74 inwardly. As the damper 62 moves relative to the rod 50, the friction force of the foam tube 74 compressed on the rod resists the movement. Thus, the radial compression of the foam tube 74 in towards the rod 50 produces a damping force that hampers axial movement of the shock absorber 54 along the rod 50. The dual compressive forces created by the foam tube 74 also increase the friction force generated when the damper 62 is moved relative to the stationary rod 50, thereby generating heat.

The foam tube 74 may be injected with grease, which helps conduct frictional heat away from the rod 50 so that the damper 62 does not overheat. The grease also helps lubricate the interface between the tube 74 and the rod 50 to prevent the foam material from damage caused by repetitive movement relative to the rod 50. The grease can also help make the foam material more compliant and less stiff to further protect the tube 74 from damage. Alternatively, the dampening insert 70 may be made as a strip of foam wrapped around the rod 50 or simply compressed in some manner and designed to function similarly to the foam tube 74 described above.

As shown in FIG. 2, a force director illustrated in the form of a socket interface 78 may be positioned on the rod 50 between the socket 46 and the shock absorber 54, and functions to redirect force on the shock absorber 54 to a vector that is substantially coaxial with a longitudinal axis X of the rod 50. The socket interface 78 may be a separate component from the shock absorber 54.

FIG. 4 is a partial sectional view of the laundry treating appliance 10 from FIG. 1, illustrating forces acting on the suspension system 12 without the socket interface 78. Ideal force, represented by vector A, transmitted to the shock absorber 54 would be coaxial with the axis X of the rod 50. However, in reality, due to the suspension interface with the tub 34, actual force, represented by vectors B is imparted onto the shock absorber 54 at an angle to the axis X. Because the actual force B is not parallel to the axis X, a portion of the force transmitted back by the shock absorber 54 will not be parallel to the axis X. One portion will be redirected in an axial direction, represented by vector C, while the other portion is redirected in the radial direction, represented by vector D. The force vector D acting perpendicular to the rod 50 adds

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a side loading to the damper 62, which may torque the damper 62 in the direction of vector D while it moves along the rod 50.

The torque applied to the damper 62 while it oscillates up and down relative to the rod 50 during a cycle of operation of the laundry treating appliance 10 can prematurely wear and damage the foam material of the dampening insert 70, which reduces the effectiveness of the damper 62 in producing friction force to reduce the movement and vibration of the tub 34. If the side loading is great enough, the suspension assembly 12 can fail within a single cycle of operation of the laundry treating appliance 10.

FIG. 5 is a partial sectional view of the laundry treating appliance 10 from FIG. 1, illustrating forces acting on the suspension system 12 with the socket interface 78. The socket interface 78 helps to manage any aspects of side loading to ensure the suspension assembly 12 does not fail and the laundry treating appliance 10 remains operable. Similarly to FIG. 5, actual force, represented by vectors E is imparted onto the socket interface 78 at an angle to the axis X. However, due to the shape of the socket interface 78, actual force, represented by vector B, imparted onto the shock absorber 54 is coaxial with the axis X, and is therefore, collinear with the ideal force vector A. Because the actual force B is parallel to the axis X, the force transmitted back by the shock absorber 54, represented by vector C, will be parallel to the axis X. Without any substantial radially-directed force transmitted back, there will be no substantial side loading on the damper 62.

The invention described herein provides a suspension system with improved force management. The socket interface 78 of the suspension system 12 redirects forces acting on the suspension system 12 to be parallel to the rod 50, which is ideal. This reduces or eliminates side loading on the damper 62, which increases the effectiveness of the damper 62 and reduces the possibility of suspension failure.

While the invention has been specifically described in connection with certain specific embodiments thereof, it is to be understood that this is by way of illustration and not of limitation. Reasonable variation and modification are possible within the scope of the forgoing disclosure and drawings without departing from the spirit of the invention which is defined in the appended claims.

What is claimed is:

1. A laundry treating appliance, comprising:
  - a cabinet defining an interior;
  - a tub located within the cabinet and having at least one socket;
  - a suspension system coupling the tub to the cabinet and comprising at least one suspension strut assembly comprising:
    - an elongated rod defining a longitudinal axis and extending between the tub and cabinet, with one end of the rod mounted to the cabinet and another end of the rod passing through the socket, and the longitudinal axis oriented at an angle relative to vertical;
  - a shock absorber, comprising:
    - a damper having a compressible portion located within a housing and wherein the damper is slidably mounted on the rod;
    - a spring having one end operably coupled to the rod and another end operably coupled to the damper; and
    - an end cap adjacent the damper and wherein the end cap forms an end of the shock absorber and the damper is located between the end cap and the spring; and

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a socket interface moveably mounted on the rod and having one end with a first surface abutting a second surface of the socket, another end opposite the first surface and having a third surface abutting the end cap of the shock absorber, and a body of the socket interface converging from the first surface to the third surface, which has a smaller area than the first surface, and wherein during operation forces imparted by the socket onto the socket interface along an axis unaligned with the longitudinal axis of the elongated rod are aligned by the socket interface to be with the longitudinal axis of the rod.

2. The laundry treating appliance of claim 1 wherein the first and second surfaces are complementary.

3. The laundry treating appliance of claim 2 wherein the first and second surfaces have substantially the same radius of curvature.

4. The laundry treating appliance of claim 1 wherein the unaligned forces acting on the first surface emanate through the third surface aligned with the longitudinal axis.

5. The laundry treating appliance of claim 1 wherein the damper comprises a compressible dampening insert surrounding the rod.

6. The laundry treating appliance of claim 1 wherein the spring is a coil spring.

7. The laundry treating appliance of claim 1 wherein the shock absorber further comprises another end cap spaced from the damper.

8. A suspension strut assembly for suspending a tub of a washing machine, where the tub includes a socket, to a chassis of the washing machine, comprising:

an elongated rod defining a longitudinal axis, with one end configured to mount to the chassis and an opposite end; a shock absorber, comprising:

a damper having a compressible portion that is slidably mounted on the rod;

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a spring having one end operably coupled to the rod and another end operably coupled to the damper; and an end cap adjacent the damper and wherein the end cap forms an end of the shock absorber and the damper is located between the end cap and the spring; and

a socket interface moveably mounted on the rod and having a body with one end having a first surface area configured to abut the socket of the tub and another end that is opposite the first end and includes a second surface area that is configured to abut the end cap of the shock absorber, and wherein the second surface area is smaller than the first surface area and the body of the socket interface converges towards the second surface area and wherein forces imparted by the socket of tub along an axis unaligned with the longitudinal axis of the elongated rod are aligned by the body of the socket interface to be with the longitudinal axis of the rod.

9. The suspension strut assembly of claim 8 wherein the first surface is shaped to direct forces acting on the first surface axially along the longitudinal axis.

10. The suspension strut assembly of claim 9 wherein the socket interface comprises a second surface, opposite the first surface, with the second surface contacting the shock absorber, and the unaligned forces acting on the first surface emanate through the second surface aligned with the longitudinal axis.

11. The suspension strut assembly of claim 10 wherein the first surface has a radius of curvature.

12. The suspension strut assembly of claim 8 wherein the compressible portion of the damper comprises a compressible friction member surrounding the rod.

13. The suspension strut assembly of claim 12 wherein the spring is a coil spring.

14. The laundry treating appliance of claim 7 wherein the shock absorber further comprises a piston spaced from the damper and adjacent the another end cap.

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